FISCAL-MONETARY POLICY INTERACTION. SVAR EVIDENCE FROM A CEE COUNTRY

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Abstract

The mix between monetary and fiscal policy actions are of vital importance on economic outcomes. The present paper integrates monetary and budgetary shock into a Structural Vector Autoregression (SVAR) model of Romanian economy. The policy mix, as well as the impact of the two policies on output gap and inflation is analyzed by means of both contemporaneous and long term identification schemes. The results over the 2000-2014 period, although generally in line with economic theory, provide no clear evidence on the strategic interaction (substituent or complementary instruments) between the monetary and public authorities. However, Granger causality and variance decomposition point to a relatively higher importance of monetary shocks in the economy.

Keywords: SVAR, monetary policy, fiscal policy, identification

Introduction and literature review

In every country, an efficient economic management depends on the understanding of shocks propagating within the economy and the interaction among them. Monetary and fiscal policy shocks interaction arises by multiple channels: monetary policy influences the budgetary one through seigniorage, inflation has effects on real public debt, fiscal discipline can affect monetary authorities' credibility, while fiscal policy and unexpected inflation have impact on employment, a major objective of the policy mix.

Both policies can and should be used for preventing extreme economic fluctuations (Sprinkel, 1963). At the same time, formulating compatible objectives of the two parties, efficient exchange of information and sustainable behavior are essential factors for assuring social welfare.

The scope of the present paper is the empirical analysis of the links intervened between monetary and fiscal policy, with an empirical application for one of the most important Central Eastern European country (Romania).

The literature focused on fiscal-monetary policy mix can be divided in four main streams: i) fiscal theory of the price level, ii) strategic interactions between fiscal and monetary policies, iii) empirical studies and iv) monetary and fiscal mix within an open economy.

Fiscal theory of the price level was developed by Leeper (1991), Sims (1994, 1997, 2001) and Woodford (1994), focusing on non-Ricardian fiscal policy.

The stream of literature related to strategic interactions between fiscal and monetary policies is mainly centered on game theory developed by Nash (during 1950-1953). In this theory, it is reached a type of uncooperative equilibrium, with unfavorable effects on general wellbeing. Dixit and Lambertini (2000) highlight that divergent objectives of the two authorities would lead to inflation and GDP values far from the ones desired.

Empirical literature aims at identifying how the two policies really behave. Mélitz (2000), using data for 19 OECD countries for 1960-1995, show that the two policies tend to move in opposite direction, thus being strategic substituents. Similar conclusions were found by Wyplosz (1999) or von Hagen (2001) for 20 OECD member states during 1973-1989.

In the last wave of studies, the correlation between fiscal and monetary policies in two or more countries is the main interest of studies (Van Aarle, 2003; Sims, 1997; Beetsma and Jensen, 2002). An important area of research is represented by Monetary and Economic Union countries, since Euro Area Member States have their own fiscal authorities, while monetary policy is realized by Central European Bank. The principal pillars of monetary-fiscal game are represented by Maastricht Treaty and Stability and Growth Pact.

Methodological framework for assessing the interactions between monetary and fiscal policies

The present paper analyses the macroeconomic effects of fiscal and monetary policy, as well as their interaction, in case of Romania, through applying a Structural Vector Autoregression (SVAR) model. This is a natural choice, as macroeconomic phenomena are characterized by feedback and reciprocal causality.

Introduced by Sims (1980), SVAR models have been used in analyzing the monetary policy, more specifically in studying the propagation mechanism of real and nominal monetary shocks. Blanchard and Perotti (2002) were the pioneers of introducing the fiscal variables (taxes and public expenses) in SVAR framework, while Favero (2002) showed that a separate estimation of monetary and fiscal policies effects would lead to biased estimators.

These models express a set of observable variables by their own lags and other factors (trend/constant). SVARs have also been used for studying money effect on GDP (Sims and Zha, 2005), demand and supply shocks importance for economic cycle (Blanchard and Quah, 1989) or the link between technologic shocks and worked hours (Gali, 1999). At the same time, these models are flexible, require only a minimum set of restrictions and offer extremely useful instruments: impulse response function (IRF), forecast error variance decomposition (FEVD) and Granger causality – comprehensively reflecting the size of impact and transmission mechanism of macroeconomic and policy shocks. These models isolate the answer of each variable to structural shocks and highlight their transmission in time.

Unrestricted VAR models are centered on investigating the shocks intervened in the analyzed variables. A shock or innovation represents the part of a variable that cannot be explained by its history or by other variables in the system. Thus, the shocks are residual terms in stochastic equation of the system. Starting from the system:

$$X_t = a_0 + a_1 X_{t-1} + a_2 Y_{t-1} + \varepsilon_{1t} \quad (1)$$

$$Y_t = b_0 + b_1 X_{t-1} + b_2 Y_{t-1} + \varepsilon_{2t} \quad (2)$$

ε_{1t} şi ε_{2t} are the innovations intervened at moment t on X and Y, while the other terms in each equation reflect the deterministic part explained by system history. The main objective of VAR analysis is examining the effects of these innovations on interest variable. For the identification of the shocks, the most used solutions are: Choleski decomposition, structural decomposition (Sims-Bernake) and Blanchard-Quah long term restrictions decomposition.

Starting from the following system with n variables:

$$Ax_t = C(L)x_{t-1} + Bv_t \quad (3)$$

where A represents a (nxn) matrix of contemporaneous relations; x_t is a $(nx1)$ vector of macroeconomic variables, $C(L)$ lag matrix; v_t innovations vector and B a (nxn) diagonal (in most cases) matrix. Multiplying by A^{-1}, we get:

$$x_t = A^{-1}C(L)x_{t-1} + u_t \quad (4)$$

where $u_t = A^{-1}Bv_t$ (5)

Equation (3) presents the structural, “real” model of the economy, which cannot be empirically observed. Only some variables in the eq. (4) can be observed, this equation representing the reduced form of the model, in which u_t are liniar combinations of structural shocks v_t, taking into account eq. (5). From here, the problem of identification of structural innovations emerges.

While a monetary shock generally refers to an unexpected movement of interest rate, a fiscal shock can be due to two basic shocks: in fiscal incomes and government expenses. Other fiscal shocks (for example in budgetary deficit) can be considered as linear combination of basic shocks. In case of fiscal policy, one has to take into account the lag between the announcement and implementation of fiscal measures, the announcement itself being able to cause movement of macroeconomic variables, before the effective change in fiscal stance.

Model estimation and results

This paper aims at estimating a SVAR with four variables: GDP (in logs), GDP deflator (in logs), money market 12 months interest rate and budgetary balance (deficit/surplus as percent of GDP) for identification of the influence of monetary and fiscal policies shocks. The model uses quarterly data for Q1/2000:Q2/2014 and was implemented in EViews and JMulti.

We followed the normal steps when dealing with macroeconomic time series: seasonal adjustment (using Tramo/Seats method for correcting outliers and eliminating special effects as “Trading Day”, “Easter” etc.) and stationarity testing. Augmented Dickey-Fuller test (Dickey, Fuller, 1979) indicates that the series are not stationary and moreover, these have different integration orders (interest rate, GDP deflator and government deficit are I(1)[1],while GDP is I(2)). For assuring an easier interpretation of the results, I applied Hodrick-Prescott (1980) filter (λ= 1600) as a method for obtaining stationary series: the used series represented the gaps of the initial variables compared to their trend.

The lag length criteria (Akaike, Schwartz and Hannan-Quinn), as well as the limited number of observations, leaded to an one-lag model, for assuring a larger number of degrees of freedom. The stability tests of the model indicated that the estimated system is not explosive, i.e. the shocks’ impact on variables diminishes until exhaustion after a certain period of time. Model’s stability is verified if all inverse roots of characteristic polynomial of estimated VAR coefficients are inside unit circle (Figure 1[2]).

Normality, homoscedasticity and autocorrelation hypotheses (u_t are assumed to follow a white noise process) were also tested and generally confirmed for the estimated model.

The last stage of the models (identification of structural innovations) is made by imposing at least $\frac{n(n-1)}{2}$ 0 restrictions on matrix A coefficients (eq. 3), where n is the number of variables.

In case of B matrix, I use a diagonal form. I estimate an exactly identified system, imposing $\frac{4*3}{2}$=6 restrictions, reflecting the causality/interdependence among variables, manifested during a quater.

Thus, the structure of contemporaneous relations is described in Table 1: the row variable is influenced, during the quarter, by column variables. The 1 on principal diagonal shows each variables is influenced by itself, the “NA” denote that the influence between variables exists, while the 0 restrictions show the lack of influence.

[1] Meaning that the first difference of the variables is stationary.
[2] All tables and figures refer to Appendix.

The abovementioned restrictions are generated by ordinary theoretical intuition on links between variables within three months:

- The contemporaneous response of fiscal policy variable to an innovation in GDP, inflation rate and interest rate is set to 0, since, in general, more than three months are needed for the Government to approve and implement new measures and for the decision process to pass the legislative body (de Castro Fernández, de Cos, 2006; Krusec, 2003);
- The contemporaneous response of output and inflation to an interest rate shock is 0 (in line with Leeper and Gordon, 1992; Leeper, Sims and Zha, 1996). If the central bank modifies the interest rate, this effect is first transmitted to money market, it influences the commercial banks' reserves and their capacity of granting loans, thus propagating further in the economy. In general, this process takes more than three months. At the same time, on short run, the prices are sticky.
- An inflationary shock (GDP deflator) doesn't influence GDP level within the three months interval.

These restrictions are in line with well-known models (IS curve, Philips curve, Taylor rule etc.).

The next step in the econometric process is testing model's coefficients stability for checking the Lucas (1976) critique (stipulating that econometric estimates are invalidated if these ignore regime changes during the analyzed period). For testing coefficient stability and whether during the period, structural changes have intervened, I applied CUSUM test, who also offers a graphical image. Brown et al. (1975) showed that if the tested indicators exit the critical margins, there is a solid base for doubting the structural stability of the estimated model. At it is shown in Figure 2, the estimated coefficients are stable, conclusion also confirmed by recursive parameters' analysis.

Based on this model, the final results (IRF, FEVD and Granger causality) can be generated.

IRFs display the shocks effects in the system and their trajectory in time. IRF for 12 quarters (3 years) are presented in Figure 3. On the first column, a shock in aggregate demand is analyzed (ε_t^{IS}): the output gap increases, followed by an increase in prices' level, which reaches the maximum level after one period. The aggregate demand increases more than the supply, causing inflation, the situation being one in which "too much money chasing too few things" (Frisch, 1983). In face of inflationary pressures, the central bank reacts by increasing interest rate, this variable thus following Taylor rule (being an increasing function in inflation). Due to the advance in interest rate and inflation, the fiscal deficit increases in the first two periods through interest payment to public debt. As the interest rate increases, inflation, output gap and public deficit reenter the normal trajectory to equilibrium levels.

On the second column, we present a shock in aggregate supply (ε_t^{AS}): once the economy is hit by a supply shock, inflation is increasing, determining the central bank to increase the interest rate (but the results are not statistically significant). This causes, by the multiplier effect, a decline in GDP, which reaches the highest amplitude in the 5th quarter. Counterintuitively, the public deficit is decreasing until the 4th quarter. As a result of restrictive monetary policy, inflation rate and output gap declines, and after the central bank reduces the interest rate, the initial shock impact decreases till exhaustion.

In the third column, we show the responses of macroeconomic and fiscal policy variables to a shock in monetary policy (ε_t^{MP}). As expected, at a positive shock in monetary policy, the output gap declines: investment (a part of GDP) reduces, loans are granted with difficulty, deposits are perceived to be more attractive and thus the aggregate demand diminishes. At the same time, restrictive monetary policy measures lead to inflation decline, evolution also determined by budget deficit contraction. After the objective of price stability is accomplished, the central bank reduces interest rate, stimulating economic activity, recovery of output gap, inflation and deficit to equilibrium levels.

On the last column, the effects of a fiscal shock (ε_t^{FP}) are emphasized: once the fiscal deficit increases, the aggregate demand advances (as the deficit is a part of the demand) and thus the GDP (this result is consistent with the ones obtained Blanchard and Perotti, 2002). The impact on inflation rate and on interest rate is not significant, although one would expect an increase in interest rate.

Taking into account all the results, the evidence on monetary and fiscal policies is mixed: we cannot identify a clear and significant pattern of interaction between the two policies.

For assessing the relative importance of each shock in the effects' hierarchy, we proceed to variance decomposition. Since shocks are unpredictable, any shock determines unanticipated variation (forecast errors) in the variables. Variance decomposition computes the share of this variation due to innovations in each variables.

In one year time, in the case of all analyzed variables, the biggest importance in their evolution is given by their past values: output gap 84 percent, inflation rate 77 percent, interest rate 75 percent and budget deficit 87 percent (Figure 4). After 12 quarters, the importance of monetary shocks increases for all variables, although it maintains below 10 percent. Even though smaller, the influence of fiscal innovation in explaining the variation of the variables also increases during the period.

For an in-depth analysis of the link between variables, I employed Granger (1969) causality test for each pair of variables, the test indicating which variables can be used in forecasting the others. More specific, x_t causes, in a Granger sense z_t , if a forecast for z_t containing information about x_t history is better than a forecast ignoring x_t.

The results indicate that at a threshold of 10 percent (Table 3):

- Output gap influences in Granger sense the interest rate level (test p value: 0.07)
- Interest rate causes in Granger sense the fiscal deficit (p value: 0.01), highlighting the importance of monetary shocks.

The method mentioned above highlights short term effects, but the imposed restrictions could be considered rather rigid, leading to insignificant coefficients from A and B matrix, as well as insignificant IRF.

Identification of structural shocks effects on the system variables can be also effectuated by imposing restrictions on long term, cumulated effects.

Blanchard and Quah (1989), Bayoumi and Eichengreen (1992) and Shapiro and Watson (1988) introduced long term restrictions with a wide variety of applications (economic cycle, money supply shocks etc.). For example, Blanchard and Quah argue that demand shocks have no permanent effect on GDP, unlike supply shocks. Long term restrictions assume that, starting from neutrality condition on long run, one can also draw conclusions about short term dynamics, with the advantage that economic theory offers more information about long-term relationships (Van Aarle, 2003).

In the structural matrix of long term relationship, we start from the long term money neutrality as we set to 0 the answer of output to innovations in aggregate supply, monetary and fiscal policy. Dalsgaard and de Serres (2000) also impose restrictions that nominal shocks should not affect real variables. Long term money neutrality assumes that a permanent, unexpected change in money supply has permanent effects only on nominal variables, not affecting the equilibrium values for real variables. This hypothesis was tested in numerous studies, which proved its applicability (Tawadros, 2007; Bullard, 1999; Coe and Nason, 1999). Long term neutrality of fiscal deficit is supported by Ricardian equivalence, taking into account the economic agents' expectations that a present tax reduction means, in fact, an increase in the future.

Another long term restriction is that inflation doesn't answer on long term to monetary shocks, as Lucas argued that there is no monetary policy that can permanently sustain output (or unemployment rate) above equilibrium levels and cannot control in long term inflation rate.

At the same time, Fischer (1976) underlines that if fiscal policy had significant short term effects, but no long term impact, than it would be the ideal stabilizing tool. Thus, we assumed that fiscal variable in the model doesn't impact on long term monetary variable or price level. Friedman (1972) also states that fiscal policy shocks are surely temporary and most probably small. Nasir et al. (2010) assume an inexistent long term interaction between fiscal deficit and inflation rate, monetarist theory stating that the government cannot influence by itself the inflation rate. Thus, C matrix of long term relations, is defined as in Table 2.

The IRFs for each variable during 48 quarters (Figure 5) have, generally, correct signs and are in line with the results of SVAR with contemporaneous restriction. Of particular importance is the confirmation of long term money neutrality (as the effect of interest rate on GDP neutralizes after 15-20 quarters). On long run, an inflationary shock is followed by a tightening budgetary policy and the fiscal policy contracts as the monetary authority is restrictive.

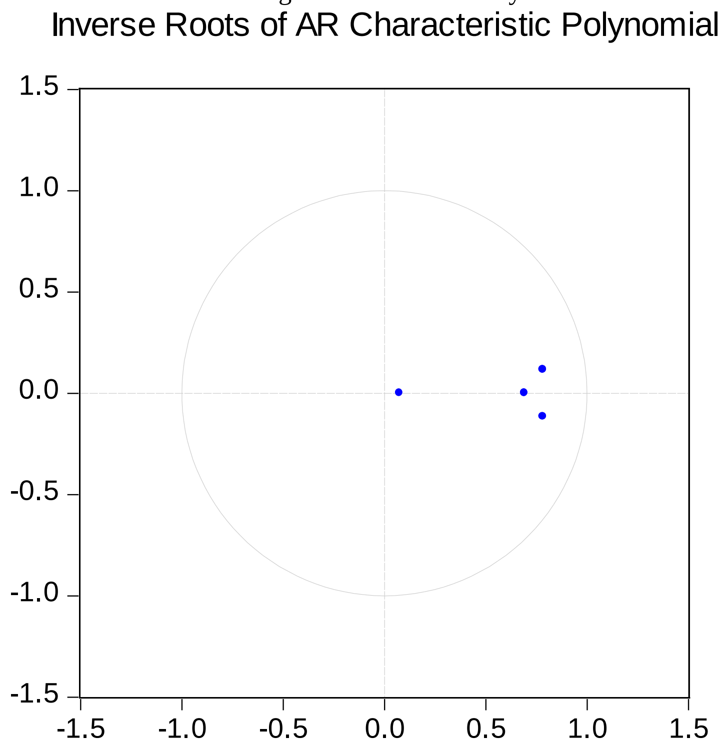
Contrary to economic intuition, it is noticed that once the interest rate is increased, the inflation rate advanced until 12 quarter. This positive relation is however often met in empirical analyses and is known as "price puzzle", since after a positive shock of interest rate, one would expect price level to decrease (Balke, Emery, 1994). An explanation for this phenomenon is proposed by Sims (1994), who argues that the central bank responds to inflationary pressures by increasing interest rate, but this measure is not enough to prevent inflation from raising. On long term, the response of inflation to a monetary shock is neutral. The effects of a shock in fiscal policy are not in general statistically significant.

Concluding remarks

The monetary and fiscal policies' mechanism of transmission is of high importance within the analysis of macroeconomic policy. This paper used a Structural Vector Autoregression model for assessing the impact of monetary and fiscal authorities' actions in one of the most important CEE country (Romania) during 2000-2014. Beyond policies' innovation, the models identified the effects of structural shocks in demand and supply on output, prices, interest rate and public deficit. There has been found mix evidence on the effects of monetary and fiscal policy. The data didn't clearly show whether the two policies act as strategic substituents or as complementary instruments in achieving the objectives. Although some results are not statistically significant, overall, the models offer convincing explanations related to the economic variables' evolution in the mentioned time frame.

Appendix

Figure 1. Model stability



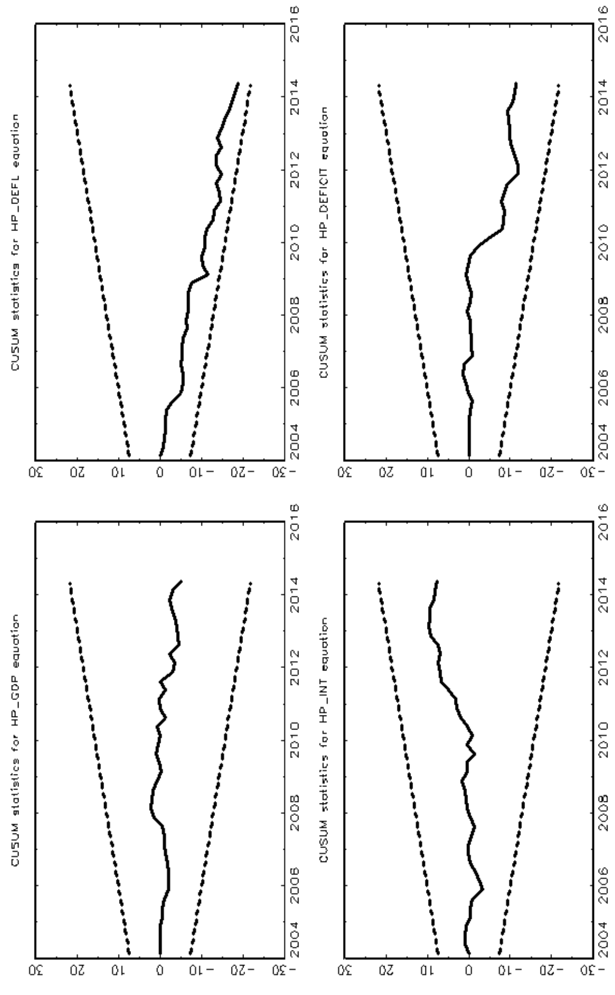


Figure 2.Cusum test

Table 1. Structure of contemporaneous relations matrix

	GDP	GDP deflator	Int. rate	Fiscal deficit
GDP	1	0	0	NA
GDP deflator	NA	1	0	NA
Int. rate	NA	NA	1	NA
Fiscal deficit	0	0	0	1

Table 2. Structure of long term relations matrix

	GDP	GDP deflator	Int. rate	Fiscal deficit
GDP	NA	0	0	0
GDP deflator	NA	NA	0	0
Int. rate	NA	NA	NA	0
Fiscal deficit	NA	NA	NA	NA

Figure 3. Impulse response functions. SVAR with contemporaneous restrictions

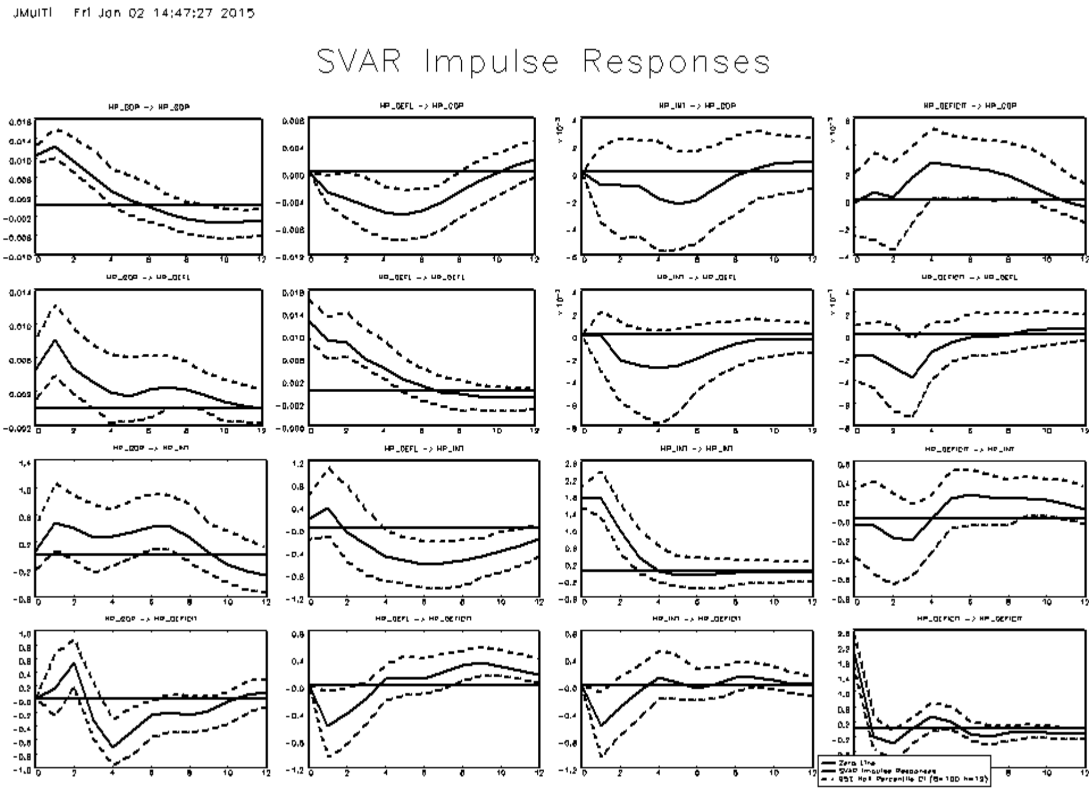


Figure 4. Variance decomposition. SVAR with contemporaneous restrictions

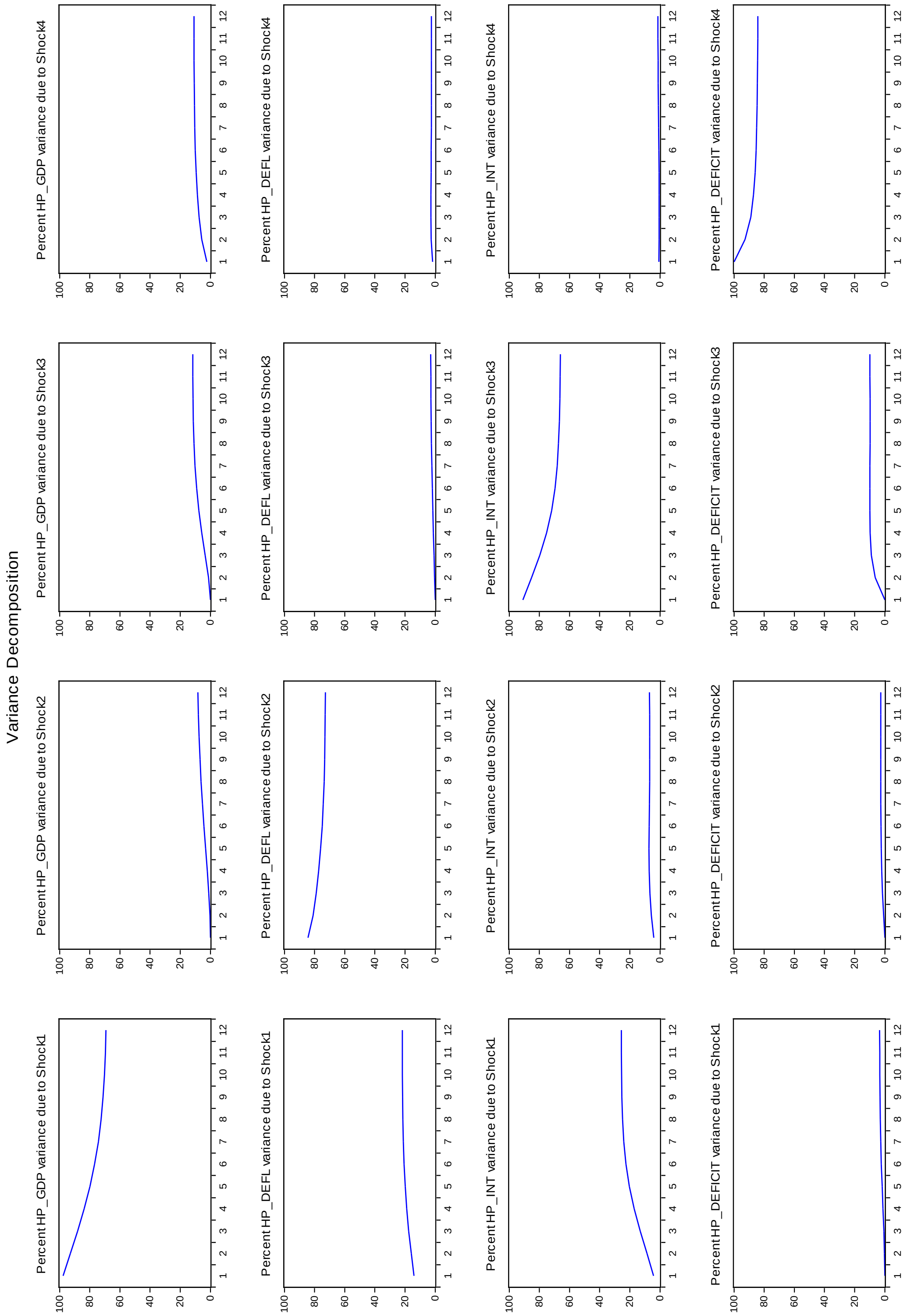


Table 3. Granger causality test

VAR Granger Causality/Block Exogeneity Wald Tests
Date: 01/02/15 Time: 10:35
Sample: 2000Q1 2014Q2
Included observations: 57

Dependent variable: HP_GDP

Excluded	Chi-sq	df	Prob.
HP_DEFL	0.479351	1	0.4887
HP_INT	2.353398	1	0.1250
HP_DEFICIT	0.906629	1	0.3410
All	5.537494	3	0.1364

Dependent variable: HP_DEFL

Excluded	Chi-sq	df	Prob.
HP_GDP	1.061806	1	0.3028
HP_INT	0.704784	1	0.4012
HP_DEFICIT	0.409794	1	0.5221
All	1.375780	3	0.7112

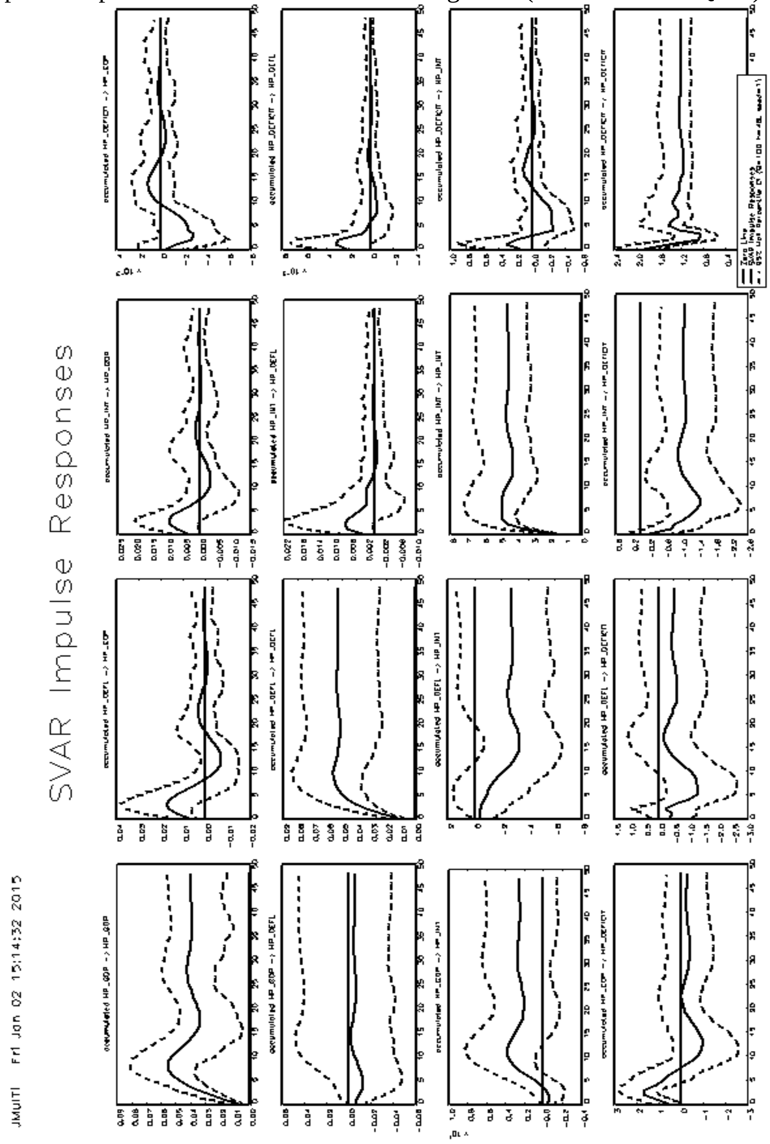
Dependent variable: HP_INT

Excluded	Chi-sq	df	Prob.
HP_GDP	**3.262991**	**1**	**0.0709**
HP_DEFL	2.040443	1	0.1532
HP_DEFICIT	0.001642	1	0.9677
All	5.533278	3	0.1367

Dependent variable: HP_DEFICIT

Excluded	Chi-sq	df	Prob.
HP_GDP	0.178308	1	0.6728
HP_DEFL	0.427567	1	0.5132
HP_INT	**7.665657**	**1**	**0.0056**
All	8.517851	3	0.0364

Figure 5. Impulse response functions. SVAR with long-term (Blanchard and Quah) restrictions



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